Water Loss Control for Military Installations

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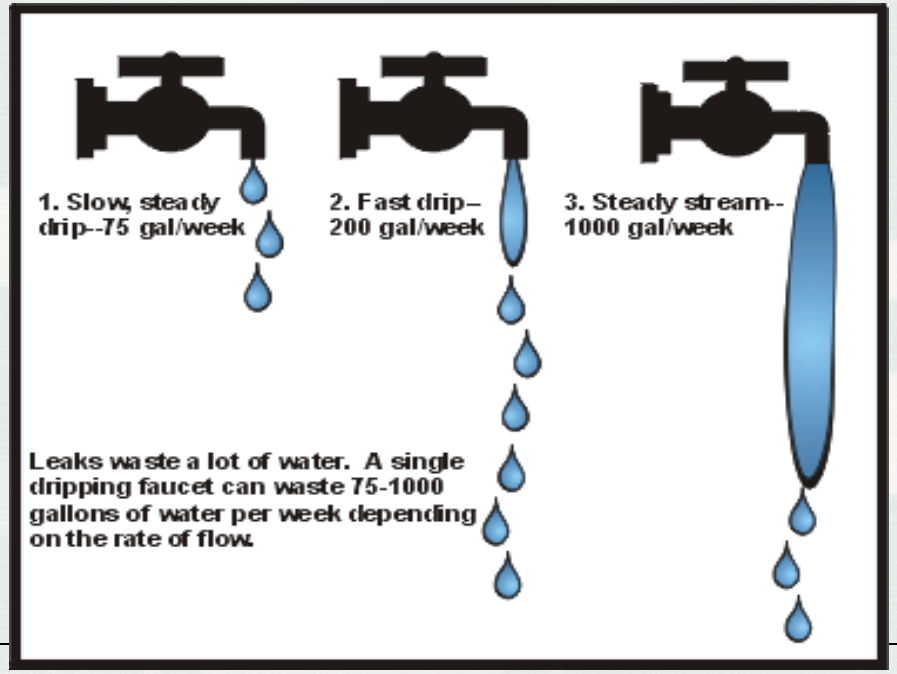
Background

- Water - Historically, Low Rates
  - Department of the Army installations used over 41 billion gallons of potable water at a cost of $67.4M in FY10.
  - By 2013, **36 states will face shortages**
  - ASCE Scorecard for Infrastructure – **Drinking Water D-**
  - North America – 12.3 percent non-revenue water
  - Leaks – **7 billion gallons per day in U.S**.
  - **Costs, value increasing**
  - Military costs much cheaper than private sector
  - Shortages
  - Competition for water
- Drivers
  - Executive Order 13514 requires reductions in water use
  - Incorporate water efficiency/conservation measures
- In U.S. leakage management is mainly reactive, based on visuals and water loss analysis
  - No regulatory pressure
  - Drought, limited resource response to political, economic and environmental concerns
- Preventive maintenance
  - Water systems underground, out of sight, out of mind

True Cost of Water

- Applicability to consumers – leak considerations
- Water itself
- Wastewater disposal
- Energy for heating, pumping, treating
- Pretreatment for some wastewater



Leak Detection

- Extremely Cost-effective, Payback Usually Few Months
- Why?
- Early Leak Detection Can Save Money
- Prevent Loss of Potable Water
- Help Prevent Major Breakages
- Useful to Minimize Expenses

Financial Incentives

- Less water used = less energy required to pump, treat and distribute
- Less chemicals required
- Production of less wastewater
- Leaks can create voids, sinkholes
- Often leaking water goes into sewers, lowering capacity
- Extended life of pumping and treatment facilities
- Improved operational efficiency
- Less disruption for highways and businesses, residents
- Lowered water system operational costs
- Reduced potential for contamination
- Reduced potential property damage and water system liability
- Reduced water outage events
- USEPA – Reduce the 650 main breaks every day by 0.5%, save 270 million gallons of water a day!

Water Loss

- Water is lost through LEAKS and BREAKS
- Leaks - result from loose joints or service connections
- Breaks – occur when a water main fractures
- Different types – service line, valves, but largest source of NRW is leaks in supply lines
- Leak cause factors:
  - Material, composition, age, joining methods, quality of initial installation
  - External factors: stray electric current, contact with other structures, stress from traffic vibrations, frost loads and freezing
- Underground leaks: rusting, stray current, heavy traffic, freeze –thaw, transient high pressure events (valve opening and closing, pump operation)

Water Loss

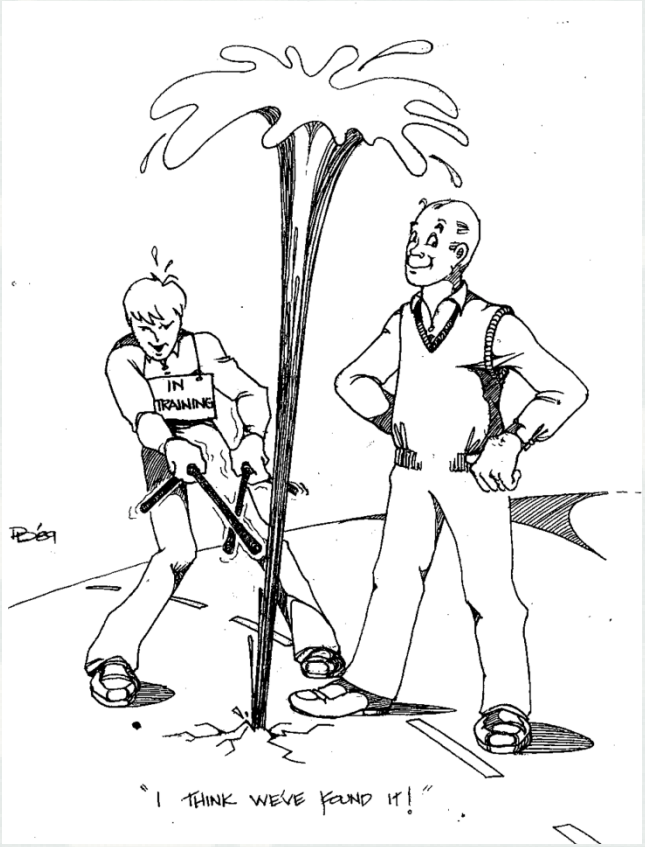
- "Non-revenue water"
  - Includes: public use, firefighting demands, unauthorized connections, etc. along with water physically lost from the distribution system
  - Difference between water produced and metered use
  - Water loss – all water that is not identified as authorized metered use or authorized un-metered use
  - Goal - 10 percent maximum

Signs of Underground Leaks

- Unusually wet spots, water pooling on surface
- Green, wet, or soft area surrounded by drier conditions
- Notable drop in water pressure/flow volume
- Sudden problem with supply quality (rust, dirt, air)
- Irrigated area no longer receives proper pressure
- Heaving or cracking of paved areas
- Sink holes or potholes
- Uneven floor grade or leaning of a structure
- Unexplained sudden increase in water use, consistently high water use, or unexplained climbing use

Why Do Proactive Leak Detection?

- Because a large proportion of leaks go unnoticed due to:
  - Highly permeable ground conditions
  - Proximity of sewers or other trenches
  - Low flow volume



Water Loss and Leak Control Technologies

- **Automatic meter reading** – advances in water meter technology can automatically record and report leakage within customer-owned plumbing by detecting a constant flow of water.
- **Continuous acoustic monitoring of water mains via valves** – sensors that record sound vibrations overnight. Downloaded and analyzed by software for leaks.
- **GIS analysis** – reviewing historical leak information by GIS mapping helps identify leak-prone areas in small diameter old pipes.
- **Improved pressure control** –reducing and modulating water pressure in water systems lowers the amount leaking out of pipes and reduces stress.
- **Large transmission main testing** – complex methods and insertion of sensors
- **Leakage control zones** – subdivide systems into zones monitored by master meters that periodically measure water use.
- **Main replacement program** – identify main break and other data to identify and replace aging mains.

Leak Detection Technologies

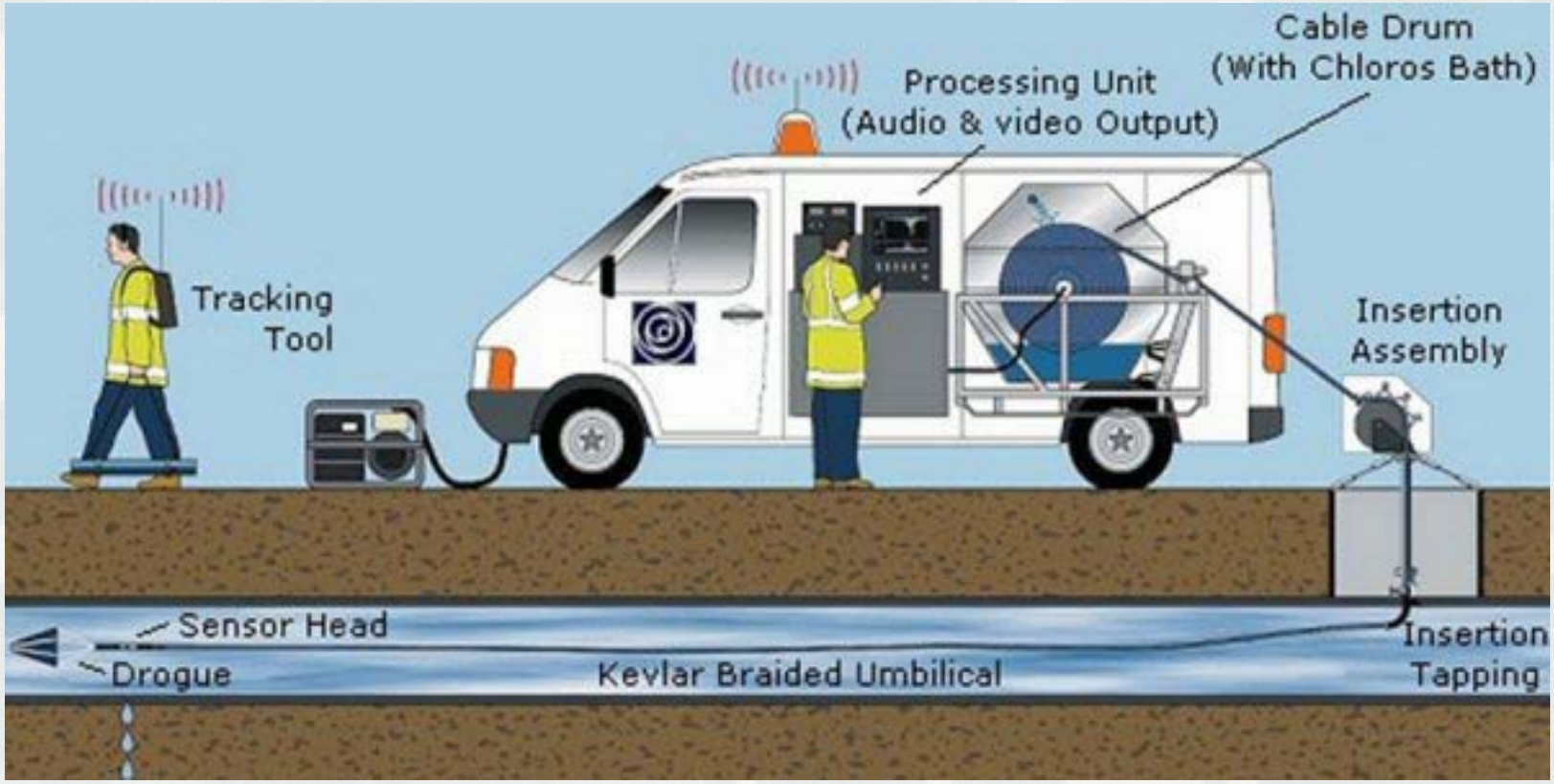
- Acoustic – most widely used
- Acoustic with correlation
- Infrared thermography – Detect leaks in pipelines and voids around them good for aircraft overflights, fast and instant feedback shows measurable temperature change
- Chemical (tracer gas)
- Ground penetrating radar – adapted for leak detection, electromagnetic wave propagation, can do rapid reconaissance over long lines
- Combined acoustic logger and leak noise correlator
- Digital correlation
- Radio-frequency interferometer – UHF radio waves transmit, reflect from leaking water
- In-line detection systems
  - Sahara
  - Smartball

In-line Leak Detection

- Pass hydrophone through the pipeline
  - ▶ Very sensitive
  - ▶ Smartball- free swimming foam ball contains core with instrumentation

SmartBall® Inspection Method – Insertion, Travelling, and Removal

Sahara in Action

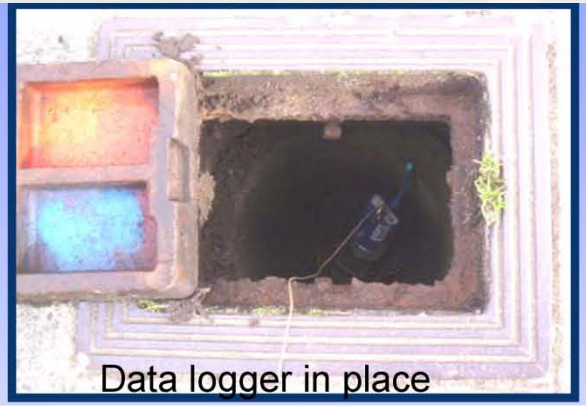


External Leak Detection

- Acoustic
  - Directly locate leak
  - Contact water main
  - Hydrophone
- Correlators
  - Based on velocity of sound as it travels– most widely used
  - Two hydrophones or sensors bracket leak
- Monitoring units
- Permanent installations over time connect to valves and water service lines
- Monitor acoustics
  - Download to or transmit to base station or website

Use of Data Loggers

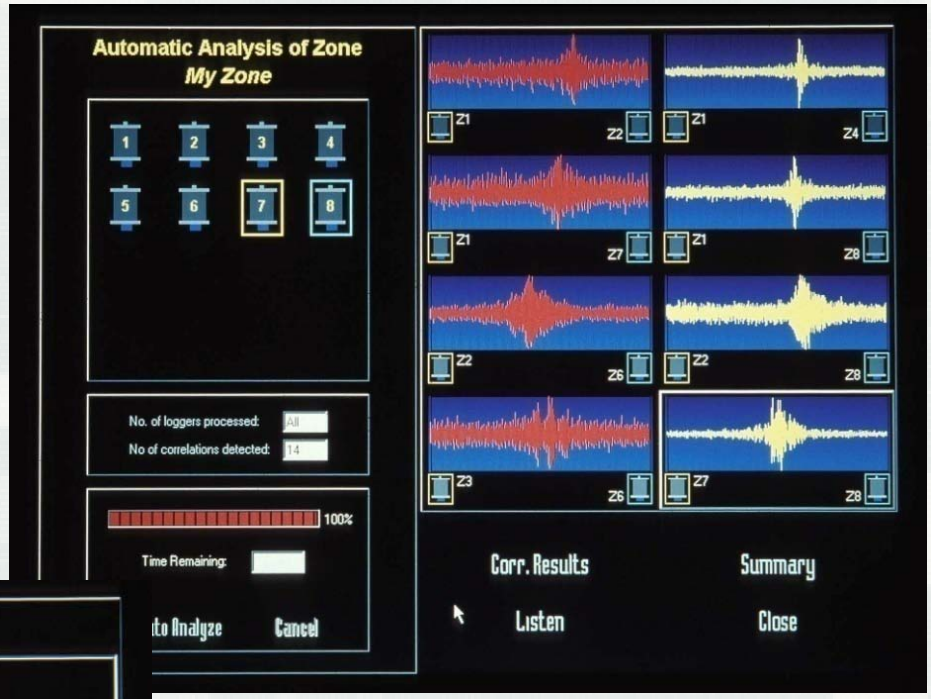
Data logger with caution plate

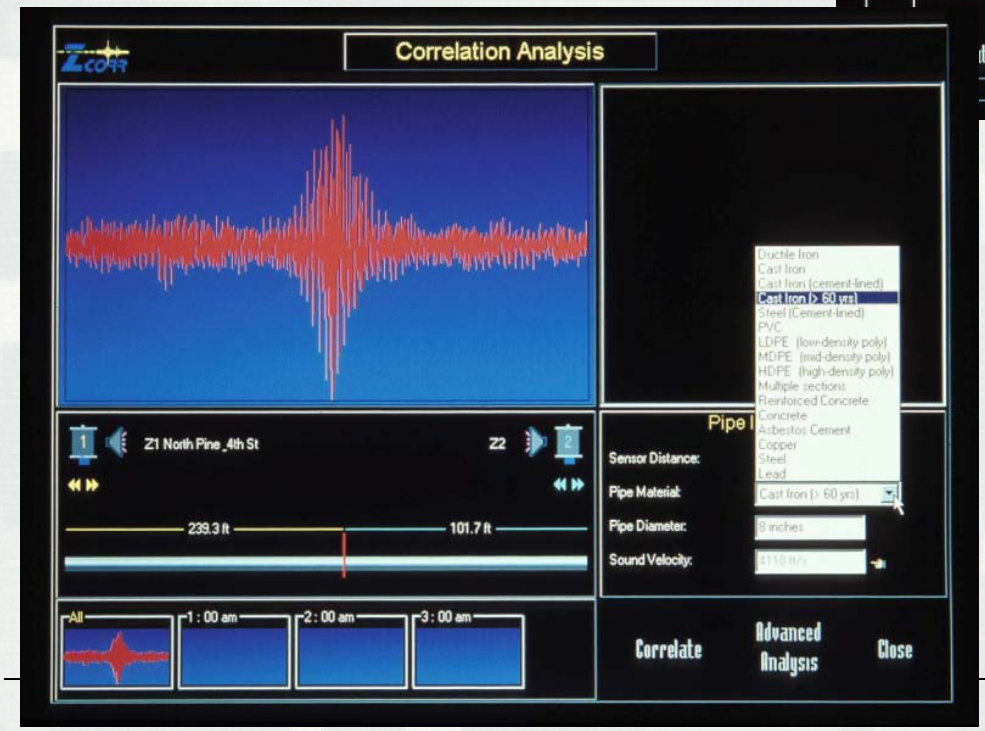

Data logger in place


portable patroller

Results from loggers

Input pipe information to pinpoint leak



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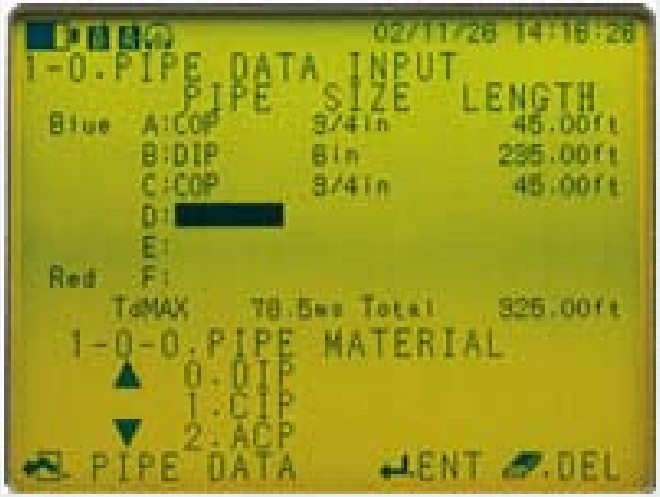

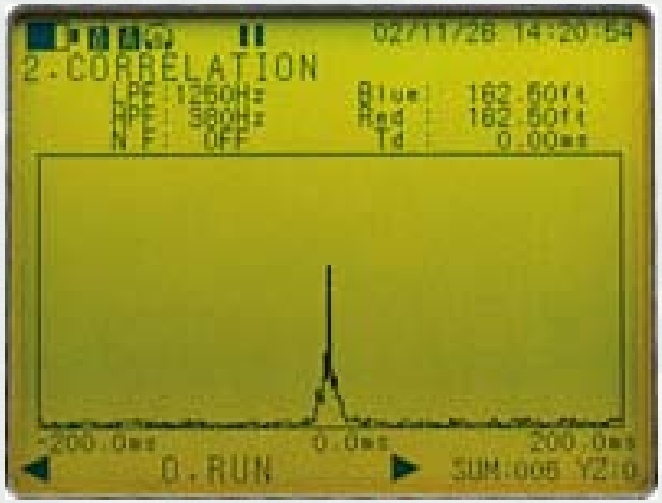

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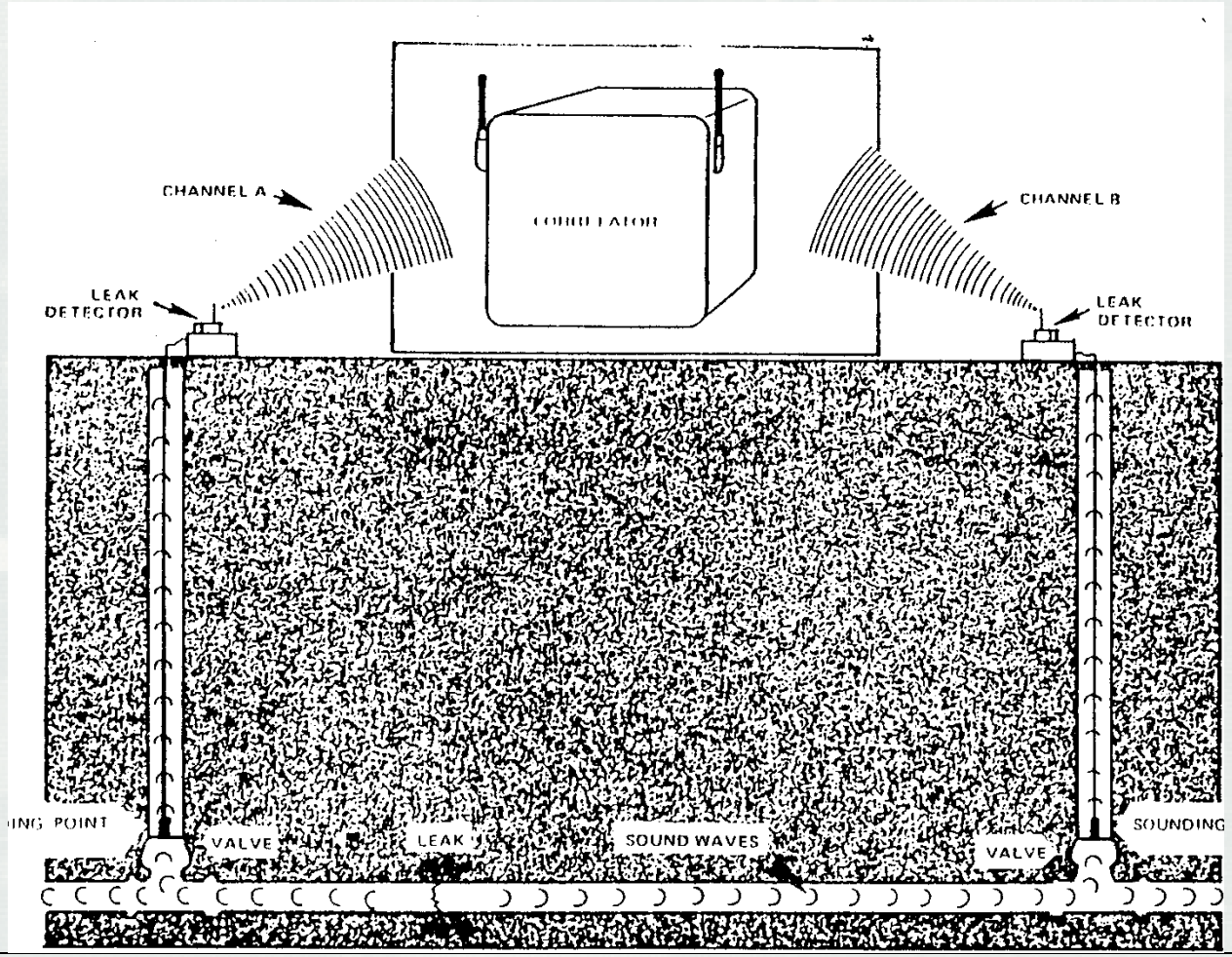
Principle of Noise Correlation for Pinpointing Leaks

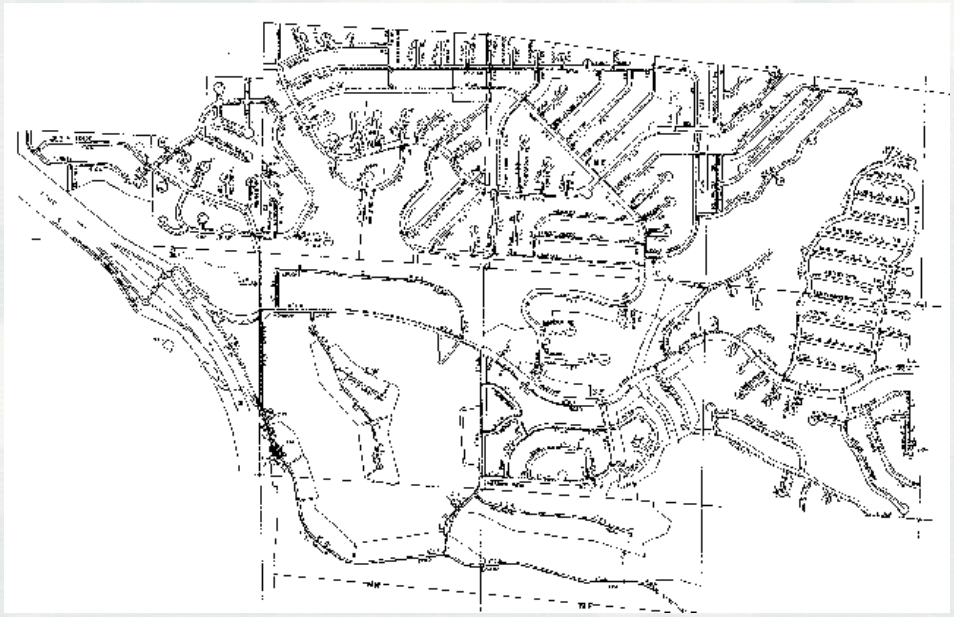


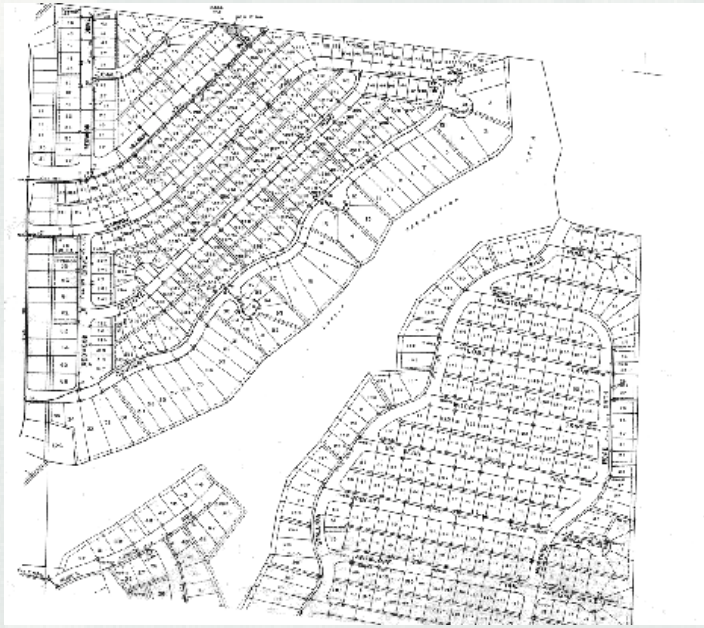
What Should be Done

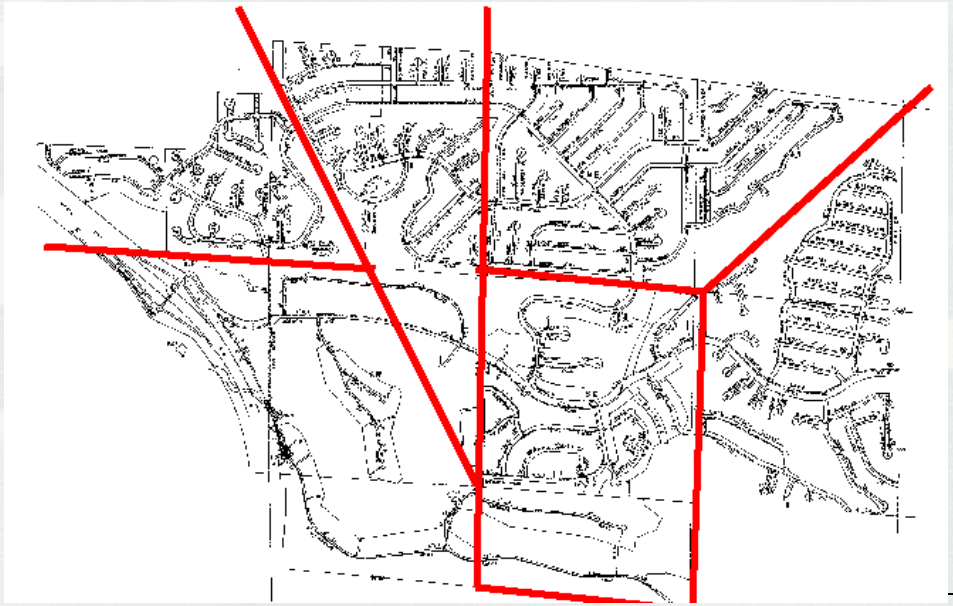
- Record review and analysis
  - Pump records, energy costs, etc.
- Determine non-revenue water
- Update maps
- Test master meters, major consumer meters
- Inventory of defects
- Recommendations for future

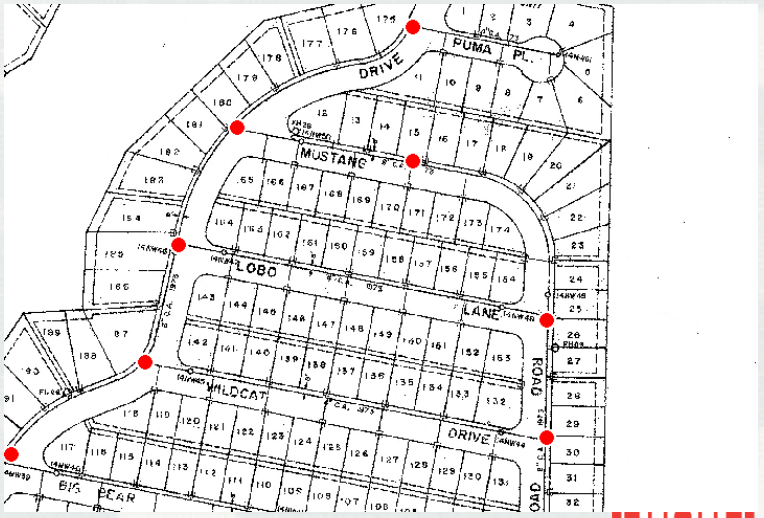
Standard Water Audit

- Quantify water consumption and water production via measurement or estimate
- Undertake water balance calculation









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Leak Detection Survey

- Distribution system
  - Contact every hydrant
  - Contact at least 50 percent of valves
  - Contact every 200 - 300 feet
- Contractor will usually do listening first, Then use correlation equipment for locating leaks

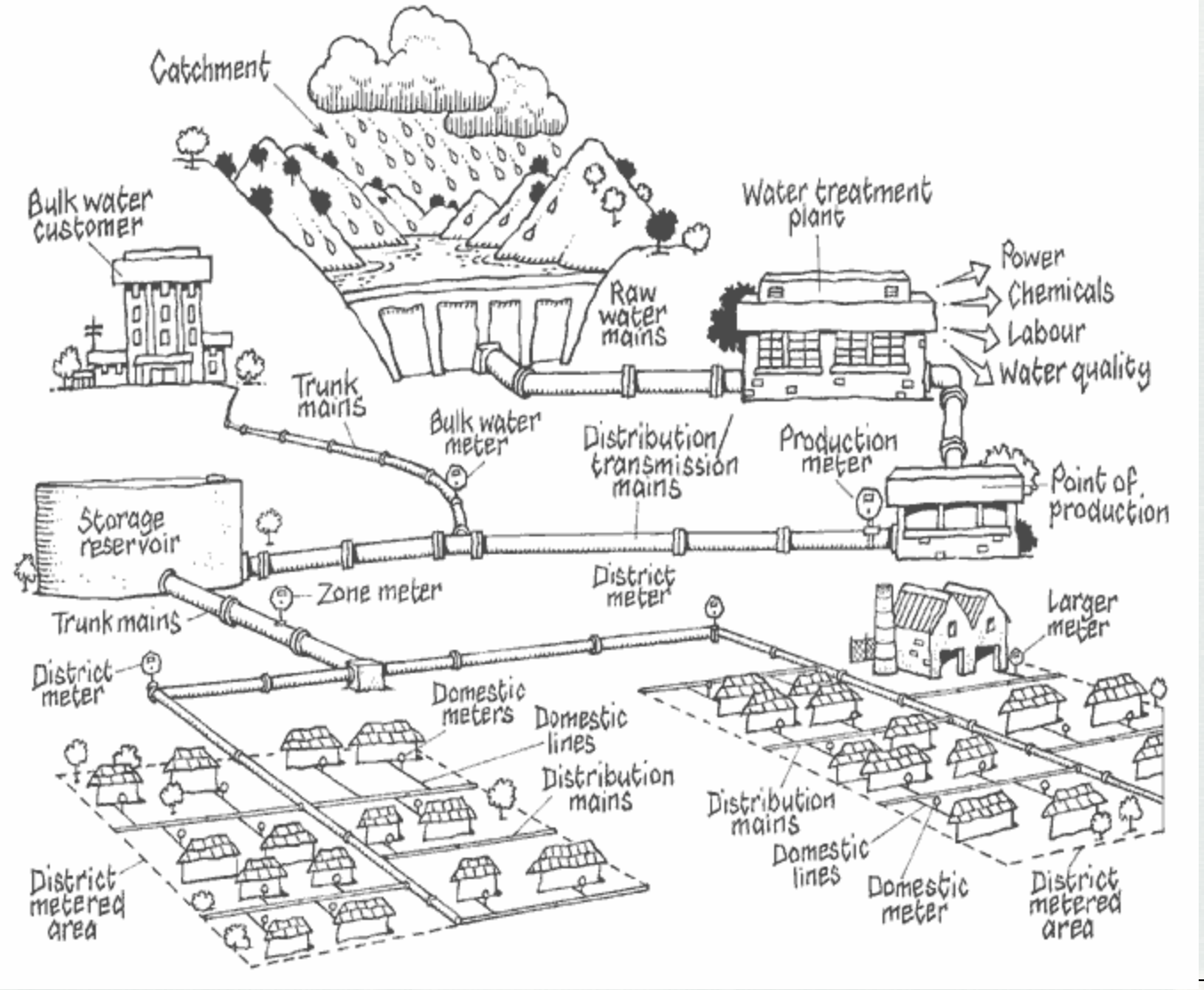
Special Consideration

- PVC Piping
  - Sound at curb stops
  - Sound every 50 feet
  - Difficult, but can be done
  - Consider impact when expanding system
  - Requires special treatment by contractor

District Metering Areas

- Some countries – water utilities subject to government regulation – pro-active leak management
- Intensive use of District Metering Areas (DMAs) common in some other countries
- DMAs approx. 500 – 300 connections
- Catching on in U.S.
- Constant feedback, ability to monitor

Water System



Installation Example

- 1989
  - 26 Leaks; 309,000 gpd total
  - 227,000 gpd in maintenance area valves
  - Hydrants - 59,000 gpd
  - Leakage cost = $126,000/year
- 1995
  - 43 Leaks; 344,000 gpd
  - 25 Leaks in maint. Areas - 200,000 gpd
  - 15 Leaks in hydrants - 138,000

Example 2 212 Miles 242,000,000 gallons per year

Source	Number	GPM	% Total	% Total GPM
Main	15	307	14	67
Services	51	79	47	17
Valves	24	68	22	15
Hydrants	18	7	17	1
Total	108	460	100	100

Example 3

Leak Type	Number	Mgal	Cost ($) @ $0.90/kgal
Main	7	80.9	72,810
Hydrant	26	6.8	6,120
Valve	19	5.0	4,500
Service	3	4.7	4,230

Example from Vancouver

How Costly Can A Leak Be ?

HYDRANT (Slide Gate)	Leak Hole Size volume-cu/ft	Start cu ft	Stop cu ft	Total cu ft	7.48 US GAL= 1-cu ft us gals/per hr	$ / m^3 (GVRD Rate) 35.3cu ft = 1m3	1 Hour	24 hours	7 days	365 days
Minor	1/2-Turn from closed	27.01	36.86	9.85	73.68	$0.52	$0.15	$3.48	$24.38	$1,271.10
Moderate	2-Turns from closed	1.15	27.01	25.86	193.48	$0.52	$0.38	$9.14	$64.01	$3,337.80

SERVICE	Leak Hole Size volume-cu/ft	Start cu ft	Stop cu ft	Total cu ft	7.48 US GAL= 1-cu ft us gals/per hr	$ / m3 (GVRD ate) 35.3cu ft = 1m3	1 Hour	24 hours	7 days	365 days
Minor	1/4 inch cut through copper	266	331	65	486.2	$0.52	$0.96	$22.98	$160.86	$8,387.76
Moderate	1/2 inch cut through copper	423	555	132	987.36	$0.52	$1.94	$46.67	$326.67	$17,033.61
Major	3/4 inch cut through copper	555	795	240	1795.2	$0.52	$3.54	$84.85	$593.95	$30,970.20

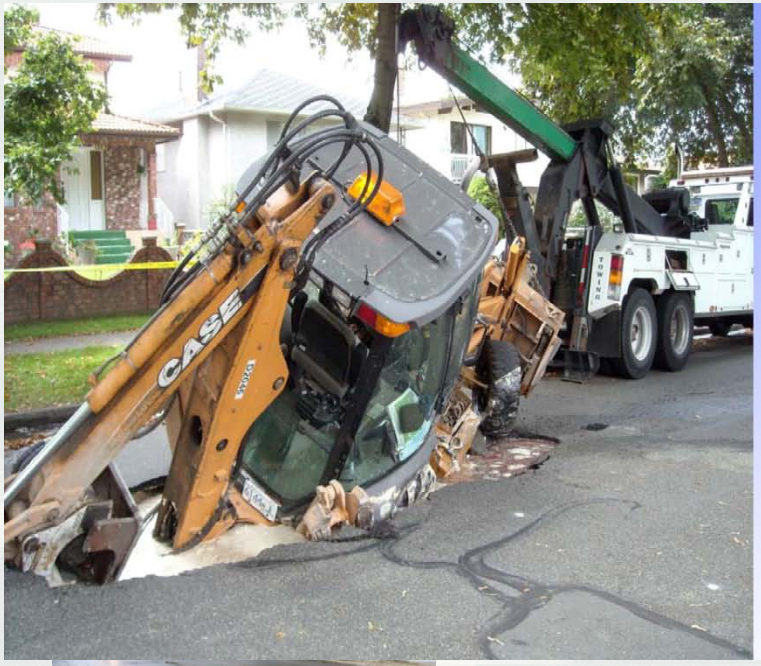
Recommendations

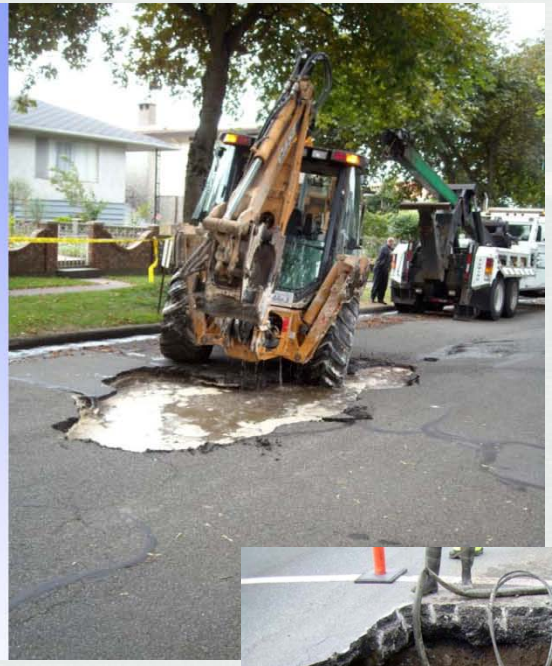
- Conduct comprehensive LDS every 2 years; may vary
- Initiate valve exercising program
- Install meters at critical points
- Update maps
- Disconnect lines no longer in use

Benefits

- Reduction in O & M costs
- Deferment of new facilities construction/expansion
- Conservation of resources
- Continuity of utility services
- Improved distribution system control
- Improved work force productivity
- Up-to-date records
- Improved knowledge of water system
- Minimize future breaks

Leak Liabilities





Summary

- Leak detection saves
  - Water
  - Money
  - Energy
  - Payback- few mos. to year
  - Variety of methods
- Other options also contribute to water loss control
  - Pressure management
  - DMAs
  - AMI, AMR

Questions, Comments?

Contact information or for additional information or resources

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